REMARKS

Applicants have now had an opportunity to carefully consider the Office Action dated October 31, 2002. Re-examination and reconsideration are respectfully requested.

The Office Action

Acknowledgment was made to a claim for foreign priority under 35 U.S.C. §119(a)-(d) that all certified copies of the priority documents had been received and placed of record in the file.

Claims 1-3 and 11-12 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Sato et al. (U.S. Patent No. 5,770,900) in view of Kawamoto et al. (U.S. Patent No. 4,954,736) and Denk (U.S. Patent No. 4,617,726).

Claim 4 stands rejected under 35 U.S.C. §103(a) as being unpatentable over Sato et al., Denk and Kawamoto et al. as applied to the base claim, and further in view of Mitcham et al. (U.S. Patent No. 5,877,578).

Claim 5 stands rejected under 35 U.S.C. §103(a) as being unpatentable over Sato et al., Denk and Kawamoto et al. as applied to the base claim, and further in view of Molnar (U.S. Patent No. 5,881,448).

Claims 6-7 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Sato et al., Denk and Kawamoto et al. as applied to the base claim, and further in view of the level of skills of a worker in the art.

The Pending Claims Are Distinguished Over the Applied Art

As a brief review, the present application is directed to a rotor structure of a motor having an inner rotor, which uses a high-performance rare earth magnet

but is low in costs and addresses problems associated with the use of rare earth magnets in such motors designed for high-speed rotation.

Independent **claim 1**, as amended, recites a yoke-less rotor rotatably disposed with a small gap from the pole teeth of the annular yokes and having a permanent magnet arranged opposite to the pole teeth, wherein the permanent magnet comprises a rare earth magnet further comprising a plurality of discrete segment magnets which are arranged apart from each other on an outer surface of the rotor. A sleeve is fitted to a rotor shaft near a longitudinal center of the rotor shaft and a thermoplastic material fills a space extending radially between the sleeve and each segment magnet, a space extending radially between the rotor shaft and each segment magnet and a space extending circumferentially between adjacent segment magnets. Similarly, independent **claim 11**, as amended, recites a yoke-less rotor rotatably disposed adjacent the pole teeth of the annular yokes. **Claim 11** also recites a sleeve fitted to a rotor shaft near a longitudinal center of the rotor shaft and a thermoplastic holder having a plurality of discrete segment magnets which are spaced from each other on an outer surface of the rotor by the thermoplastic holder that fills a space extending radially between the rotor shaft and each segment magnet, a space extending radially between the rotor shaft and each segment magnet and a space extending circumferentially between adjacent segment magnets.

In the instant Office Action, the Examiner has rejected independent **claims 1 and 11** under 35 U.S.C. §103(a) as being unpatentable over Sato et al. in view of Kawamoto et al. and Denk, and the Examiner asserts that Sato et al. discloses a stepping motor structure having an inner rotor assembly differing from the claimed invention in only two respects. First, it was admitted

that Sato failed to disclose the use of a rare earth magnet. Second, Sato did not space discreet magnet segments apart with a thermoplastic material. However, the Examiner asserted, in the first respect, that Denk teaches a rotor having a rare earth magnet. In the second respect, it was asserted that Kawamoto et al. teaches an inner rotor assembly comprising a plurality of discrete magnet segments which are arranged apart from each other by thermoplastic material, wherein the inner circumferential edge of each magnet segment is longer than the outer circumferential edge to accommodate the fastening projections and the thermoplastic resin bonding therebetween.

Applicant respectfully traverses the Examiner's assertion with respect to Kawamoto et al. for the following reasons. It is an objective of the present application to provide a rotor structure that addresses problems related to the use of a rare earth magnet in an inner rotor assembly as set forth on page 1, lines 16-23 and page 2, lines 7-11 of the Background of the present application. Neither Sato et al. or Kawamoto et al. teach solutions to these special problems incurred by the use of rare earth magnets. Denk describes a rotor structure having rare earth magnets, however, Denk uses a sleeve, and preferably adhesives, to hold the magnets into pockets machined into a non-magnetic outer cylinder having a magnetizable inner cylinder fitted inside with a good fit (col. 3, line 65 - col. 4, line 6).

Kawamoto et al., at col. 3, lines 40-52, teaches a preferred rotor yoke 12 formed by stacking many yoke element sleeves, obtained by punching such magnetic material as silicon steel plate, and shaping the sleeves. The sleeves have holding projections projecting radially outward and expanded in their width at radially extended tip ends. A resin layer fills a gap between the sleeves and the magnets (col. 4, lines 17-37).

Neither Denk or Kawamoto et al., however, teach solutions to the problem of using low mechanical strength rare earth magnets in a yoke-less rotor. The present application discloses a highly productive rotor assembly method, utilizing resin forming based on a high polymer material (page 1, lines 16-21). The present application teaches a yoke-less rotor wherein a space between the shaft 3 of the rotor and each discrete segment magnet 4, and between adjacent segment magnets 4, is filled with resin 17 except for the sleeve 12. This is described in the instant specification beginning at page 4, line 21, and running to page 5, line 7.

The rotor assembly of Denk, however, is a complex assembly requiring the above-described machining of pockets and fitting of a sleeve on a magnetizable inner cylinder. Kawamoto et al. teaches a rotor having the above-described rotor yoke formed by stacking many yoke element sleeves, obtained by punching such magnetic material as silicon steel plate. In contrast, the present application teaches a rotor not requiring the machined metallic sleeve and cylinder of Denk or the stacked yoke element sleeves of Kawamoto et al. Instead, only a resin molding is utilized in their place. The resin molding fills the space between the plurality of discrete segment magnets and the rotor shaft and the space between adjacent segment magnets.

Further, the rare earth magnets of Denk's motor cannot be combined with the inner rotor of Kawamoto et al. by one skilled in the art because the rotor of Kawamoto et al. does not address the problem of cracks occurring in the magnets due to a forming pressure in a resin forming method (page 1, lines 16-21). The portions of the resin molding filling the space between the segment magnets in the present application serves as a relief for the resin pressure caused by molding. This prevents cracks from forming in the low mechanical

strength rare earth magnets (page 3, lines 22-25). The molded resin layer 18 of Kawamoto et al. does not teach or fairly suggest the function of relief for resin pressure as taught by the present application, nor does the thickness of the resin layer, about 0.2 mm (col. 4, lines 3-12) suggest such a function.

Still further, the yoke-less design of the rotor taught by the present application further distinguishes the applicant's rotor from the rotor taught by Kawamoto et al. in combination with the rare earth magnets taught by Denk.

Still yet further, the limitation of a sleeve fitted to a rotor shaft in **claims 1 and 11**, as amended, further distinguishes the applicant's rotor from the rotor taught by Kawamoto et al. in combination with the rare earth magnets taught by Denk.

Applicant has added dependent **claims 14 and 16**, depending from **claims 1 and 11**, respectively, adding a further limitation wherein the sleeve comprises an aluminum material. Applicant has further added dependent **claims 15 and 17**, also depending from **claims 1 and 11**, respectively, further describing the space filled by the thermoplastic filler in a preferred embodiment of the present application. It is respectfully submitted that these claims further patentably define the claimed invention over the applied references.

Independent **claims 1 and 11** have been revised to more clearly recite the features disclosed by the present application and not taught or suggested by Denk, Sato et al. or Kawamoto et al., even in combination. Independent **claims 1 and 11** should, for the above-described reasons, be in condition for allowance, and **claims 2-7, 12 and 14-17**, depending therefrom, should likewise be in condition for allowance.

For the reasons detailed above, it is respectfully submitted all claims remaining in the application are in condition for allowance. An early notice to that effect is therefore earnestly solicited.

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the Claims

Claim 1 has been amended as follows:

1. (Twice amended) A motor structure having an inner rotor assembly, the motor structure comprising:

a stator including annular stator yokes each having a plurality of pole teeth located along an inner circumference thereof and coils arranged inside said stator yokes, each coil being constructed by winding a magnet wire; and

a yoke-less rotor rotatably disposed with a small gap from said pole teeth of said annular yokes and having a permanent magnet arranged opposite to said pole teeth,

wherein said permanent magnet comprises a sleeve fitted to a rotor shaft and a rare earth magnet further comprising a plurality of discrete segment magnets which are arranged apart from each other on an outer surface of the rotor with a thermoplastic material that fills a space between [a] the rotor shaft and each segment magnet and a space between adjacent segment magnets.

Claim 11 has been amended as follows:

11. (Twice amended) A motor having an inner rotor assembly, the motor comprising:

a stator including annular stator yokes each having a plurality of pole teeth located along an inner circumference thereof and coils arranged inside said stator yokes, each coil being constructed by winding a magnet wire; and,

a yoke-less rotor rotatably disposed adjacent said pole teeth of said annular yokes [and having a permanent magnet arranged opposite said pole teeth ; and,

wherein said permanent magnet comprises a rare earth magnet further] comprising:

a sleeve fitted to a rotor shaft;

a thermoplastic holder; and,

a plurality of discrete rare earth segment magnets arranged opposite said pole teeth which are spaced from each other on an outer surface of the rotor by [a] said thermoplastic [material] holder that fills a space between [a] the rotor shaft and each segment magnet and a space between adjacent segment magnets, the space between adjacent segment magnets providing a relief for a molding pressure of said thermoplastic holder.

Claims 14-17 are new claims.